UNCLASSIFIED CONFIDENTIAL SECRET

ROUTING AND RECORD SHEET

INSTRUCTIONS: Officer designations should be used in the "TO" column. Under each comment a line should be drawn across sheet and each comment numbered to correspond with the number in the "TO" column. Each officer should initial (check mark insufficient) before further routing. This Routing and Record Sheet should be returned to Registry.

FROM:					TELEPHONE NO.	
TSS/ [redacted]						25X1
					DATE 28 Feb. 1955	

TO	ROOM NO.	DATE REC'D	DATE FWD'D	OFFICER'S INITIALS	TELEPHONE	COMMENTS
1. TSS/ED	2-003					MIL131B material has transmission rate max at 25X1
2. [redacted]		S	for action			0.101 gms/sq ft/24hr. This is less than Mylar material. Lets put our heavy duty material in this test and have mylar tested under MIL-131B.
3.						Howie - Is 2e. ours?
4.						Sample #110 is our box, #3.
5.						
6.						File: Burial Pkg. 1955
7.						
8.						
9.						
10.						008632
11.						DOG 25 REV DATE 27 JUNE 80 BY 057447 ORIG COMP 056 OPI 56 TYPE 30 ORIG CLASS C PAGES 14 REV CLASS C JUST 2 NEXT REV 2010 AUTH: HR 70-2
12.						
13.						
14.						
15.						

FORM 1 MAY 54 51-10 PREVIOUS EDITIONS MAY BE USED

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(40)

MOISTURE VAPOR PERMEABILITY TEST OF BARRIER MATERIALS

CONFIDENTIAL

24 February 1955

Introduction

Tough, flexible, positively sealable moisture barrier materials are needed to provide for safe burial storage of a variety of devices for periods up to several years in length. In support of the development of such materials TSL was requested to set up a procedure and install equipment necessary for testing the moisture vapor transmission of mechanically satisfactory materials both rigid and flexible. This report gives the results of tests run to date at Station II and discusses plans for future support of the program.

Summary

1. Of all combinations of materials tested to date a Mylar film - aluminum foil - Mylar film laminate showed the best resistance to transmission of moisture vapor. The material had an overall thickness of 0.005 inch and transmitted 15 milligrams of water vapor per square foot per day. This is equal to 5.5 grams per square foot per year.

2. Testing experience has indicated the desirability of making alterations in the equipment and procedure. Checks are to be run evaluating the altered equipment before further tests are made on new materials.

Details

1. Apparatus and Procedure

The procedure and apparatus used for moisture vapor transmission tests were adapted from apparatus and procedure under development at the National Bureau of Standards. The adaptation of apparatus selected for use at Station II is shown on the attached sketch.

The transmission chamber consists of two parts. The lower is a closed iron pipe 8 inches deep and 4.25 inches in inside diameter. This provided an area of 14.08 square inches through which transmission could occur. A glass tube inserted through the side near the bottom served to adjust for atmospheric pressure changes during the course of a run. The upper end of the 8 inch pipe was flanged.

The top part of the chamber likewise was an iron pipe, capped, about 5 inches in length and fitted with a flange corresponding to the flange on the lower pipe. An inlet tube carried inert gas, dry nitrogen, to the upper side of the test material, clamped between the upper and lower flanges. The gas after sweeping the upper chamber, left through the outlet tube shown at the left of the diagram.

Nitrogen gas, regulated in flow by a reducing valve on a 200 cu. ft. gas cylinder, was passed through a drying tube, then through

the transmission chamber and finally through a drying tube before being exhausted to the atmosphere. Flow rate was adjusted to about 10-20 c.c. per minute.

In operation two test pieces which had been quite well dried (about one week in a desiccator) were clamped in two transmission chambers having water in the lower compartment to within one inch of the test material, and two other test pieces, similarly dried, were clamped in transmission chambers which had no water in their lower compartments. These latter served as blanks.

Moisture transmission was determined by daily weighings of each of the drying tubes connected in the exit lines of the flow systems. The four chambers were run in parallel.

Anhydrous magnesium perchlorate was used as the moisture absorber in drying tubes.

To insure against leakage around edges of test pieces, they were sealed at the flanges by a wax-rosin sealant compound. Eight bolts through the flanges served to hold the upper and lower compartments tightly together.

Because differences in surface texture (i.e. rough vs. smooth) may affect the rate at which water vapor is swept clear of the surface by the carrier gas and therefore indirectly the rate at which moisture can be transmitted from one side of the test material to the other, the same side of all test pieces used in a test is placed toward the upper or exit side of the chamber. Before inserting in the chambers, the test pieces are cleaned thoroughly with water and a detergent to remove any water repellent materials that might be on the surfaces.

2. Materials Tested

To date transmission tests have been run on the following materials:

a. Bureau of Standards test samples - laminated plastic. This was run to check out the apparatus.

b. Dacron fabric coated with polyethylene (this was run both with and without a pre-drying).

c. A laminate of Mylar film - aluminum foil - Mylar film.

d. A laminate of Mylar film - polyethylene film - Mylar film.

e. A polyester resin bonded glass fabric such as is used in dropping containers.

3. Test Results

Test data are given in Table I and shown in Figures 2 - 8 at the end of this report. Transmission data in Table I are taken from the levelled off portions of the graphs in Figures 2 through 8 and are reduced to the units shown in the table. The data show that

in this test:

a. The Mylar - aluminum - Mylar laminate is superior to all others tested as a moisture vapor material. A transmission rate of 0.015 grams per square foot per day or 5.5 grams per square foot per year was obtained.

b. Pre-drying the samples greatly decreases the time required to reach the steady state transmission rate characteristic of the material.

4. Discussion

Although as will be pointed out later, the procedure used is not entirely sound, it is believed that the actual moisture vapor transmissions reported do not exceed the values given in the tables. Therefore, a container 16 inches in diameter and four feet long (approximately 19.5 sq. ft.) would transmit 109 grams of water per year, an amount that could be absorbed, for instance, by about three-quarters of a pound of anhydrous copper sulfate without the relative humidity in the container rising above 25%, or by about $2\frac{1}{4}$ lbs. of anhydrous copper sulfate without the relative humidity rising above 5%. This is based on the additional assumptions that:

a. A seal can be made that is as good a barrier as the base material;

b. The temperature does not exceed 90-95°F;

c. The container is in contact with water vapor only and not liquid water under any appreciable pressure;

d. The material is neither cracked, gouged, nor torn in the process of enclosing and burying its charge.

The laboratory test serves primarily as a screening device to select those materials that are worth trial in actual burial tests.

As presently set up, the moisture vapor permeability test should be run in a constant temperature, constant humidity room. Neither of these conditions is available at present at [redacted] and it would not be feasible to set up the constant humidity condition until the new quarters are occupied at [redacted] 25X1

However, it may be possible to correct for variable humidity conditions (which affect only the blanks) by sealing off the sight tubes on the transmission chambers containing the blanks. This will be tried.

Temperature control will be considered at [redacted] and set up if feasible. 25X1

Two other modifications to be carried out are insertion of a bubble tube or other flow indicator in each of the lines and insertion of a weighable drying tube after the drying cylinder in the line. At

present flow rate is checked only once a day at the time of weighing the moisture pick-up tubes. There is no way at present of checking the dryness of the nitrogen gas going into the transmission chambers. Insertion of the drying tube would provide for such a check.

Tests of these changes will be made before further samples are tested.

[redacted] 25X1

Chief, TSS/TSL

Attachments:
Figs. 1-8, inc.
Table I

Distribution:
TSS/ED - Orig. [redacted]
AC/TSS/R&D - 1 (w/att.)
TSS [redacted] - 1 " 25X1
TSS/SRB - 1 "

TABLE I

MOISTURE VAPOR PERMEABILITY DATA

Sample Number	Material	Date of Test	Thickness of Sample (Inches)	PERMEABILITY	
				Grams/Sq. Ft./Day	Grams/Sq. Ft./Yr.
103	Fiberglas - Aluminum - Fiberglas Laminate	15 Aug. - 21 Aug. 1953	.062	0.031	11.3
104	NBS Samples Laminated Plastic	7 Oct. - 13 Oct. 1953	.059	0.020	7.3
106	Polyethylene Coated Dacron Fabric	31 Mar. - 9 Apr. 1954	.045	0.046	16.8
107	Polyethylene Coated Dacron Fabric	5 June - 14 June 1954	.045	0.040	14.6
108	Mylar - Aluminum - Mylar Laminate	16 July - 22 July 1954	.005	0.015	5.5
109	Mylar - Polyethylene - Mylar Laminate	28 Sept. - 12 Oct. 1954	.005	0.040	14.6
110	Resin - Fiberglas Board T-39 Ammo Box	Jan 16 - Jan 26 1955	.126	0.031	11.3

DIAGRAM OF APPARATUS
FOR
MOISTURE VAPOR TRANSMISSION TEST

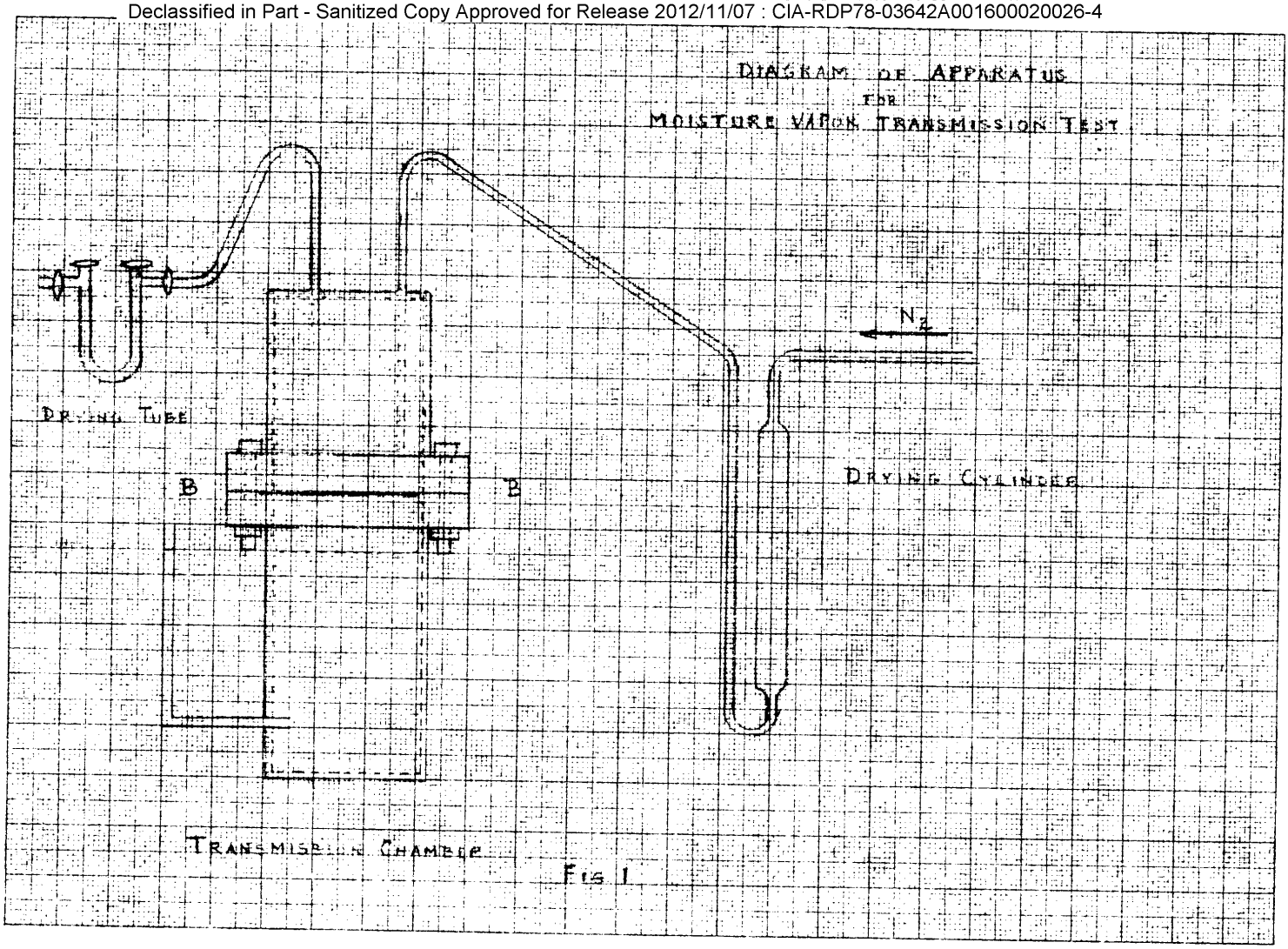
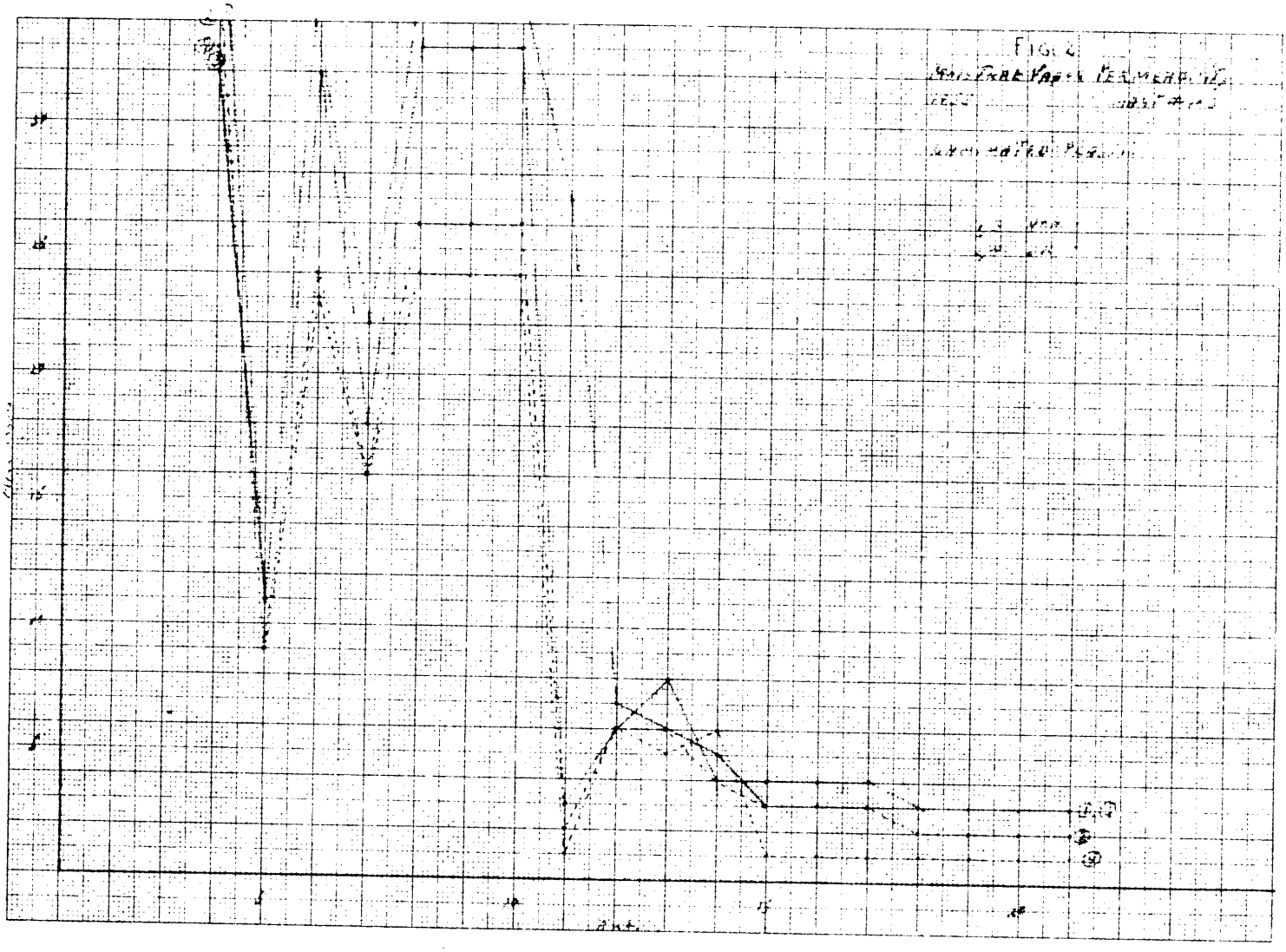
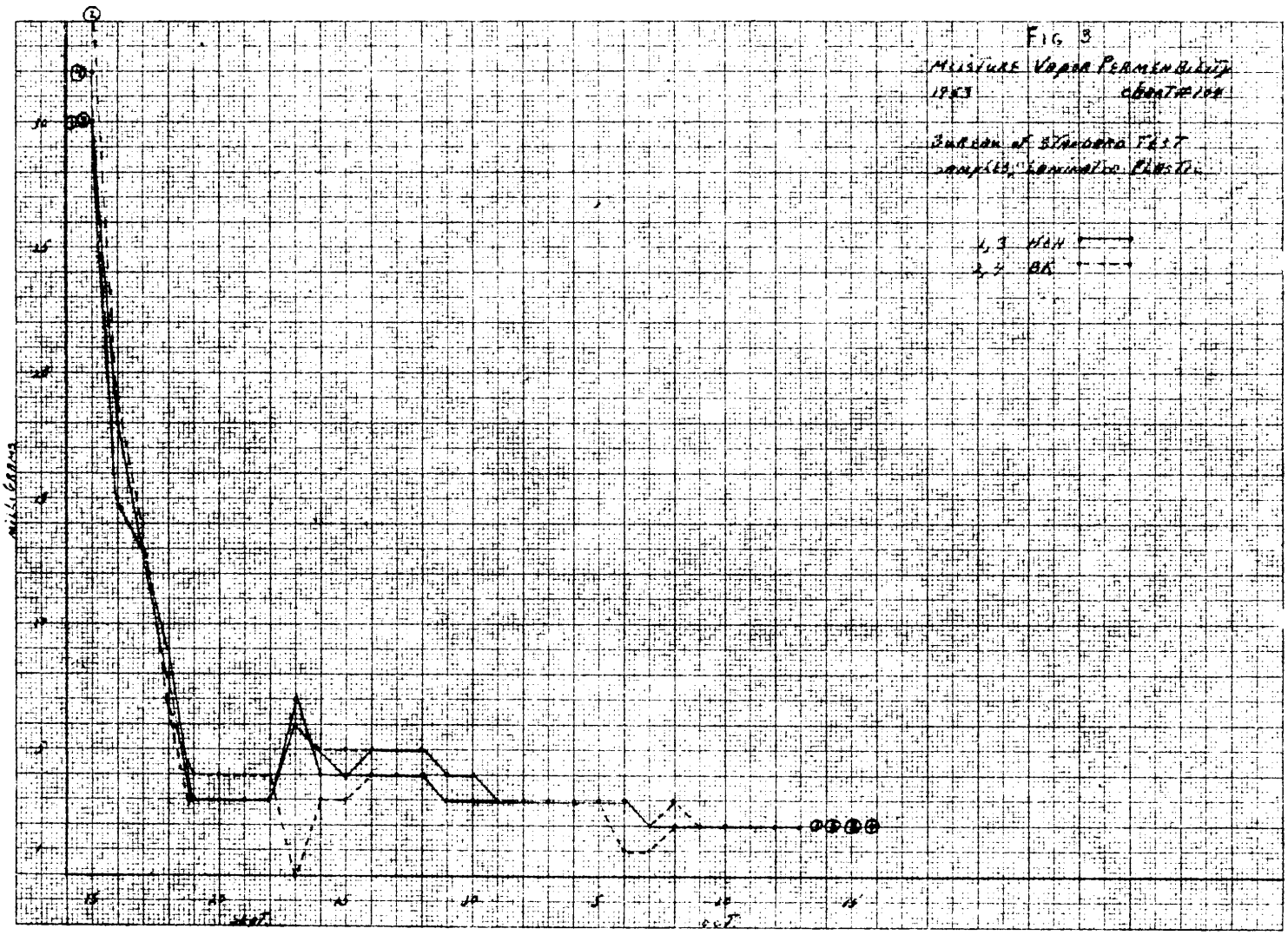
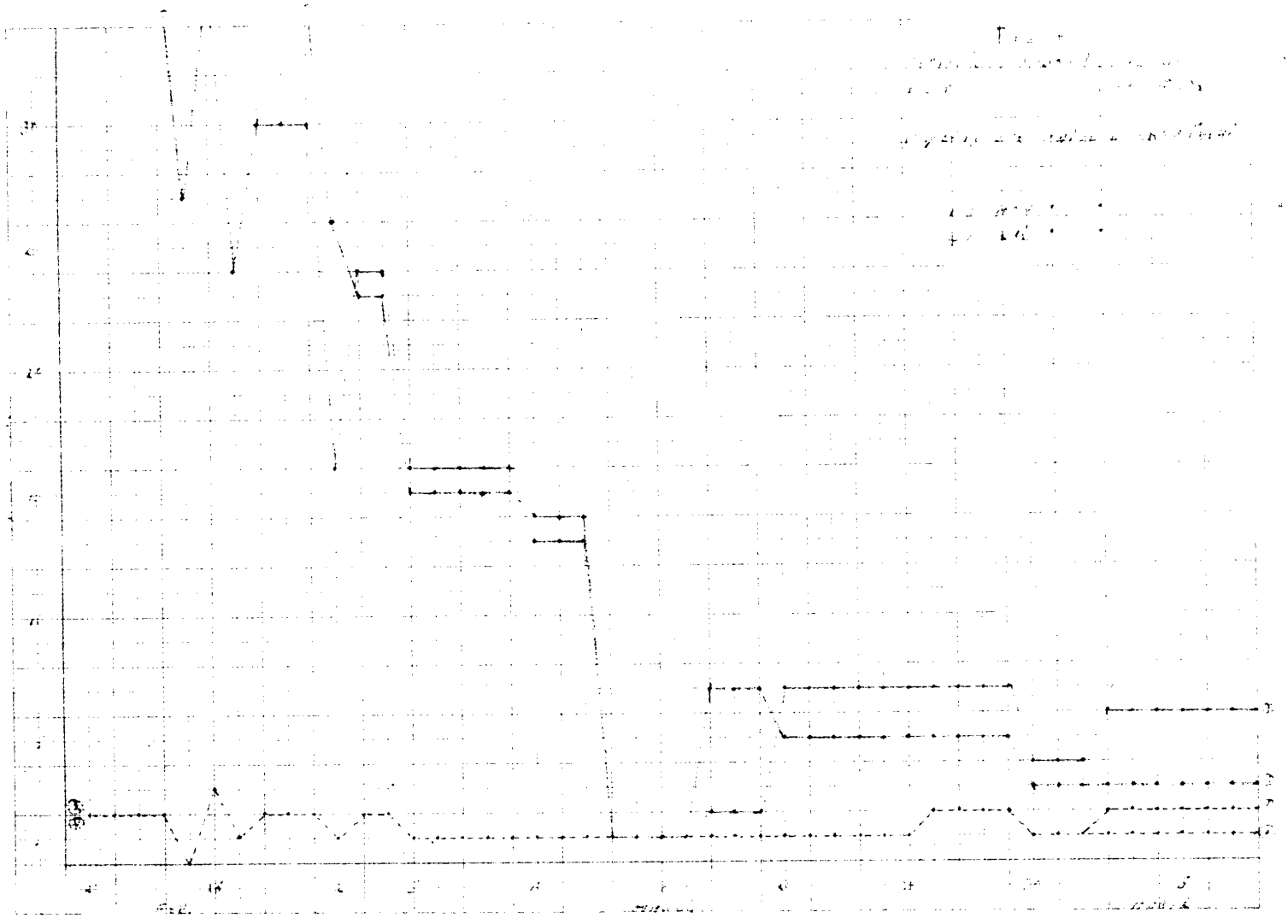


FIG 1







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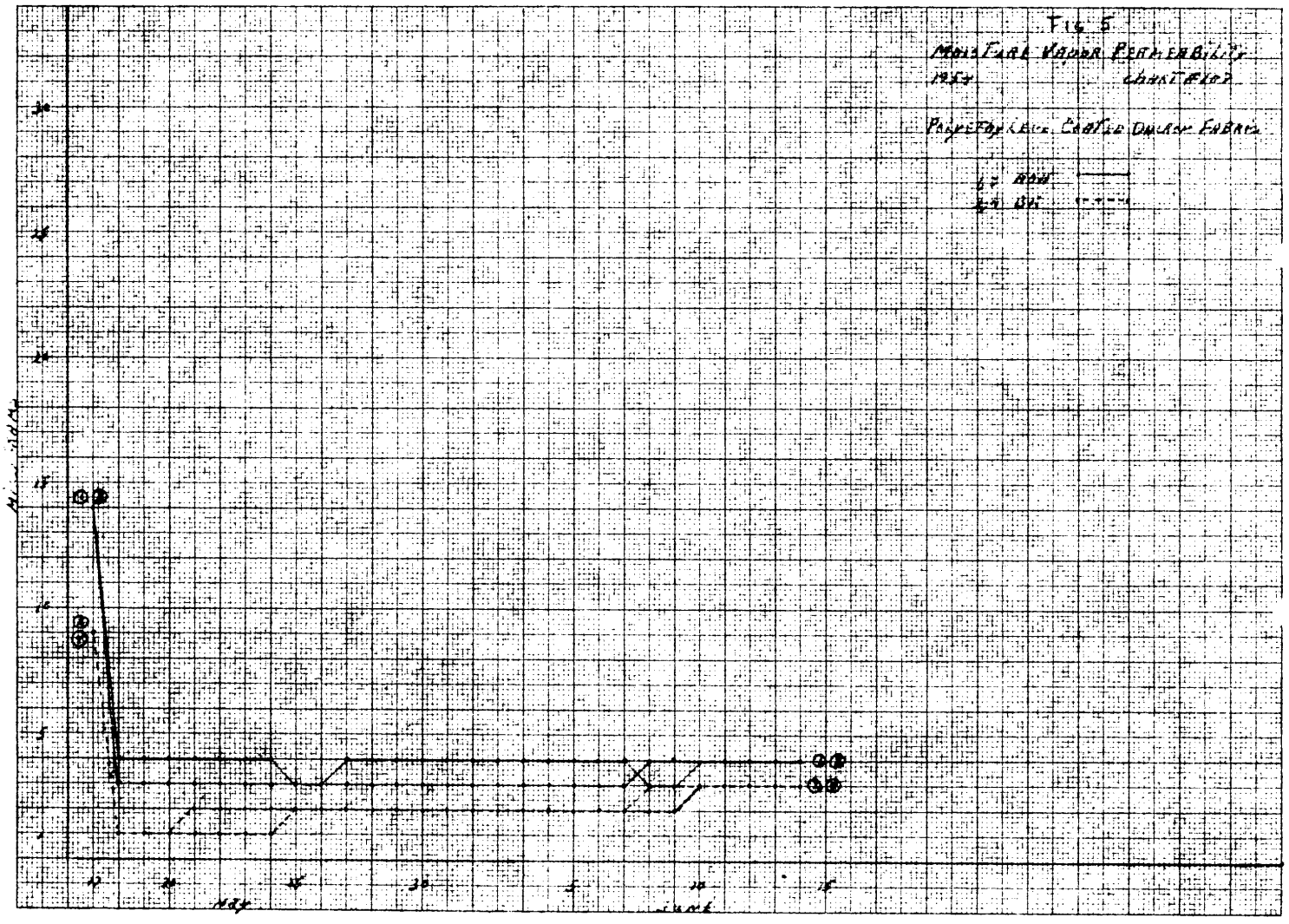

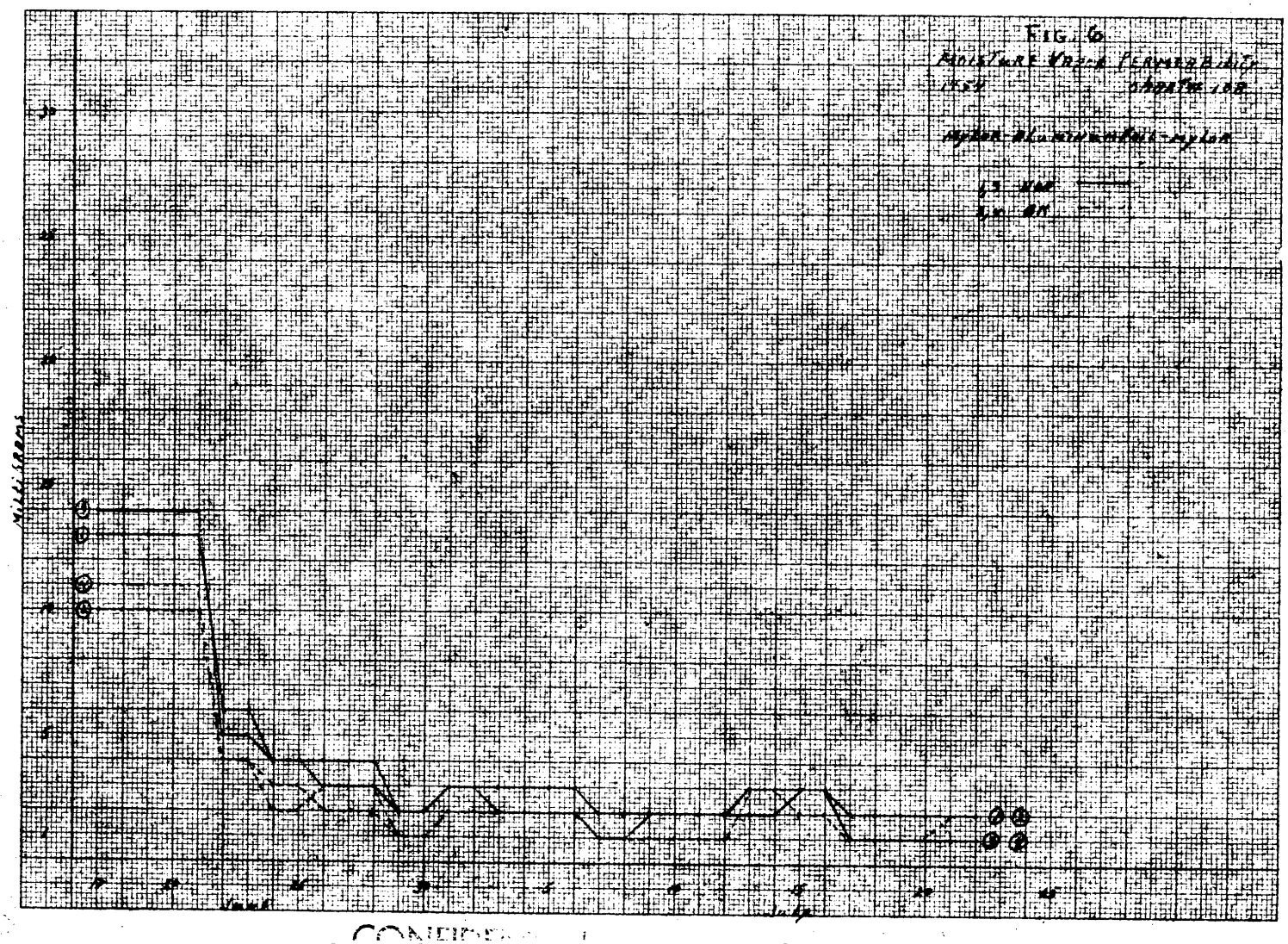

FIG. 6